Tesla Roadster: The Electric Car that Redefines "Power"

New Power to the People

August 28, 2006 - By Eckhart Beatty

ELECTRIC RIDE
THE TESLA ROADSTER PUTS THE CHARGE BACK INTO SUPERCHARGED. THIS ALL-ELECTRIC, HIGH-PERFORMANCE SPORTS CAR IS POWERED BY THE SAME BATTERIES THAT RUN YOUR LAPTOP. WIRED GOT THE FIRST GUIDED TOUR. – J.D.
MOTOR
AT THE HEART OF THE AC ELECTRIC MOTOR IS A HIGH-EFFICIENCY ROTOR THE BREAKTHROUGH IT'S MADE OF BRAZED COPPER WHICH IS MORE CONDUCTIVE THAN CONVENTIONAL ALUMINUM ROTORS
COOLING
THE INVERTER'S TRANSISTORS PRODUCE VERY LITTLE HEAT ALLOWING THE CAR TO USE LIGHTWEIGHT ENERGY-EFFICIENT AIR COOLING WHICH VENTS THROUGH A TAILPIPE
HEATING
SINCE THERE IS NO CONVENTIONAL ENGINE TO PROVIDE CABIN HEATING THE ROADSTER HAS AN ELECTRIC HEATER ONE BONUS IT DELIVERS HEAT IMMEDIATELY – NO WAITING FOR AN ENGINE TO WARM UP
PARTS
TESLA WAS DEALS WITH VARIOUS MANUFACTURERS TO SUPPLY THE WINDSHIELD WIPERS BRAKES SUSPENSION AND OTHER COMPONENTS – THERE'S NO NEED TO REINVENT THE HIGH-PERFORMANCE WINDSHIELD WIPER
BATTERY PACK
THE POWER SUPPLY IS SPLIT INTO 11 SECTORS OF 621 LITHIUM-ION CELLS EACH SECTOR IS CONTROLLED BY ITS OWN PROCESSOR WHICH MONITORS THE CHARGE AND DISCHARGE RATE OF EVERY CELL
SAFETY MONITORS
AN ACCELEROMETER SMOKE DETECTOR VOLTAGE METER TEMPERATURE GAUGE AND WATER SENSOR CAN DETECT A CRASH OR OTHER FAILURES AND SHUT THE BATTERIES DOWN TO PREVENT FIRE OR EXPLOSION
INVERTER
THE INVERTER USES 72 INSULATED TRANSISTORS TO TRANSFORM THE BATTERY'S DC ENERGY INTO AC POWER IT DELIVERS ALMOST 80 PERCENT MORE POWER THAN GM'S NOW-DISCONTINUED EV1

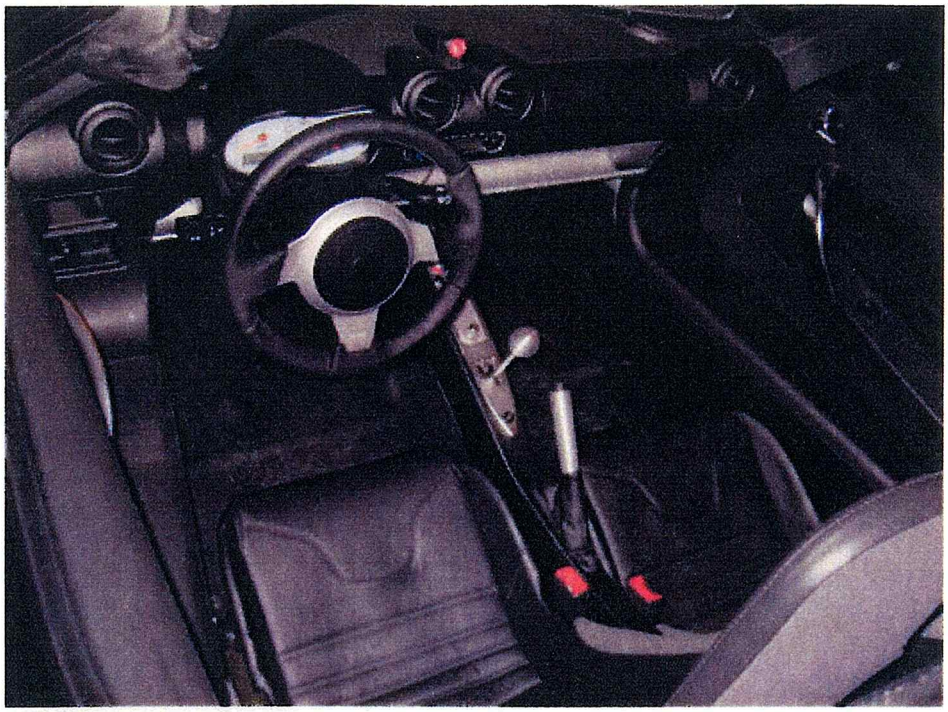
[This is a guest review by Eckhart Beatty. -Ed]

Engine trouble? Forgot to change the oil and air filter--again? Or did the transmission give out? Need any other major repair job? Someday you may never have these headaches again. Enter Tesla's Roadster. It's electric and its features eclectic. This new uber sports car–launched in July, 2006—will never require a call to Car Talk. The two popular Boston radio hosts might be scratching their heads between calls.

We've profiled the car at TreeHugger already, but given its paradigm-shifting design, we feel its technical side merits a review in itself; here we'll demonstrate what actually makes it tick.

We're looking at an electric car that is fundamentally different in probably almost every conceivable way from any other vehicle you've heard of or driven. Taking a closer look inside, we

examine the mechanical specifications of the car as discussed in the whitepaper co-authored by founder and CEO Martin Eberhard; it is available at Tesla's website.



Tesla's flagship Roadster sports a very unique design—in more ways than one. The power system comes most immediately to mind. Historically battery capacity was limited by its unweildly mass as well as of the inconvenience of finding recharging stations and then waiting to get the juice refreshed. In this marque, those employed are based on essentially the same Lithium-ion variety found in the typical laptop PC. Chosen due to their superior charge capacity as well as longevity, the batteries themselves are far superior to the lead-acid variety (well over 100,000 miles—a four to one advantage).

The power supply is partitioned into 11 sectors of 621 cells, each of which is linked to its own processor, serving to monitor both the rates of charge and discharge for each cell. This structure makes for "intelligent," dynamic charging throughout to coordinate optimal performance of the system as a whole.

The inverter relies upon 72 insulated transistors to convert DC energy into AC power. Since transistors generate little heat, the air cooling system is simple and not heavy. As for heating inside, electric-generated heat can be delivered "immediately" on demand—no more waiting for the engine to warm up on a sub-freezing winter morning!

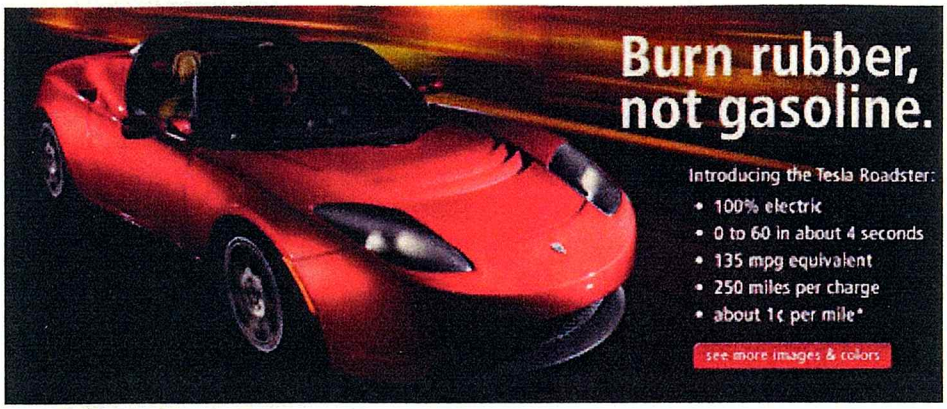
The regenerative braking system (popularized by cars such as the Prius but discussed in scientific journals for decades) captures some of the vast amount of energy typically lost in automotive systems. As a by-product of this integrated system, it places virtually no wear on the

brakes themselves since gears in the generators capture much of energy normally wasted when the typical car brakes.

More importantly still, there are far fewer moving parts to repair or maintain, since it has no internal combustion engine. According to the whitepaper, "The only work that a well designed electric car will need for its first 100,000 miles is tire service and inspection." The battery longevity is rated for the same distance.

Owing to enhanced technology, the Roadster gives its driver nearly 80% greater power than the now-defunct EV1, GM's famous flagship electric car. The rotor at the center of the AC motor is made of brazed copper, which is more efficient than the conventional construction made of aluminum. A revolutionary design, it represents a new "plateau" of sorts in the electric car world. The start-up derives its name from the famous engineer Nicholas Tesla who invented the AC induction motor, a breakthrough in his time.

To ensure optimal safety, a host of sophisticated features are always on the watch for signs of trouble. A computer works in conjunction with the drive train and sensors to deliver optimal road traction and reduced wear on the tires. Some other devices include a smoke detector, voltage meter, temperature gage, water sensor, and accelerometer to detect rapid changes in car velocity typical of accidents. Upon impact in such an event, the batteries' built-in "intelligence" enables them to shut off to avoid an explosion or fire.


Burn rubber,
not gasoline.
Introducing the Tesla Roadster:
• 100% electric
• 0 to 60 in about 4 seconds
• 135 mpg equivalent
• 250 miles per charge
• about 1¢ per mile*
see more images & colors

New Power to the People

If Tesla's philosophy seems revolutionary, it's because it is. It's unabashedly here to "make waves," to redefine the rules throughout the industry. It's simply not meant to be like any other car on the road today.

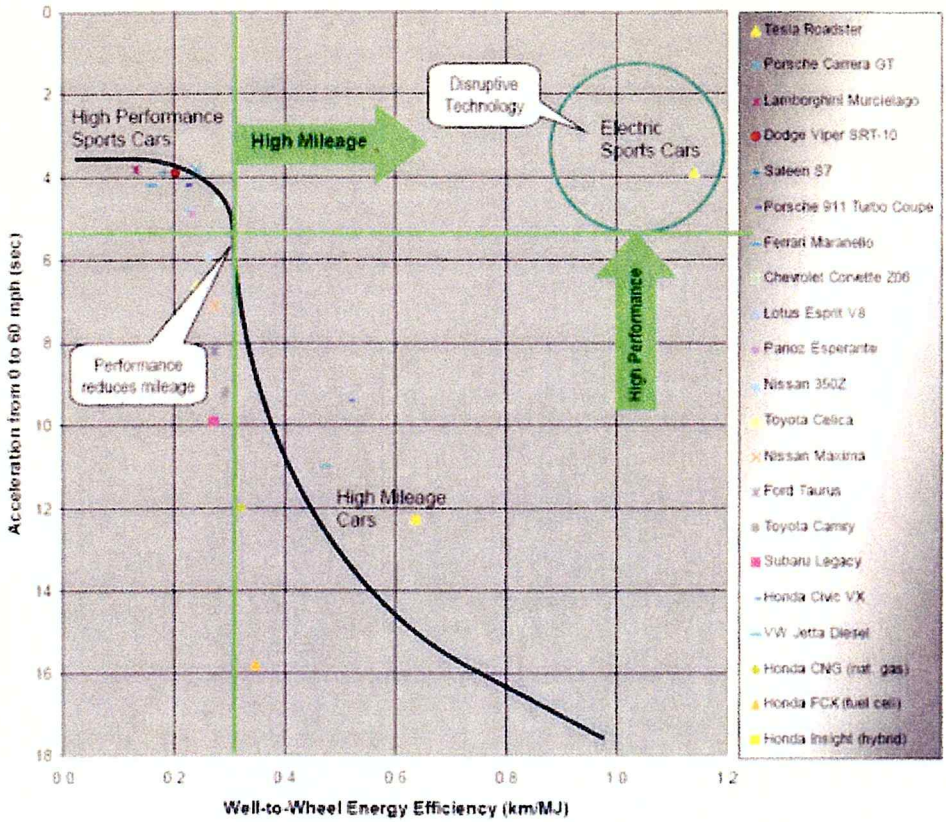
Fast (sometimes referred to as "muscle") cars have always won the hearts of the driving public. But the perception of speed has driven many to purchase cars that sport acceleration they don't really need and top speeds that are—well, (ecologically and economically) unsustainable. Based on the spiritual precept that "time is an illusion," speed and acceleration become dubious notions or values, as well, since they are both functions of time. But the love of cars won't die easily. We must concede the fact that America still adores its cars, and probably always will--particularly sporty ones.

What if you could enjoy the pick-up without sacrificing the wallet? With Tesla, drivers can actually have their cake and "drive it," too--if you will. You sacrifice only driving range (albeit a generous 250 miles) and just over three hours charging time. But you would never have to wait in line at another gas station again or worry about finding gas. Electric rates should be essentially the same (almost "free") wherever you go.

Perhaps implicit in Tesla's mission, it would appear that from now on the new definition of "power" inherent in automotive technology should be shifted to acknowledge the relative savings they afford you as you travel from points A to B in comfort and style and the luxury of not having to decide which gas is the cheapest.

Behind the Design Coup: Disruptive Technology

In most industries, a radically different design or technology comes to the fore every so often. Such a design, coming seemingly "out of nowhere" and attaining what author Malcolm Gladwell refers to in his book of the same name a "tipping point," can "take over" almost overnight. Market analysts refer to this as a "disruptive" technology or business practice.



Disruptive technologies--such as those found under the Roadster's back seat—may be coming just around the corner now in the automotive industry. Anyone who has read Clayton Christensen's *The Innovator Dilemma* will recall dramatic examples of these in a number of divergent industries. Cars' internal combustion engines have--curiously--resisted such disruptions with respect to their engine designs since their inception in the late 1800s. (We probably have the fossil fuels industry to thank for this.) These engines are still overwhelmingly dominant after just over a century. However, with declining supplies of oil in these tense times in the Middle East, and the damage Katrina wrought to the oil ports in the Gulf of Mexico, the climate may be ready for a dramatic shift away from fossil fuels, or a disruption.

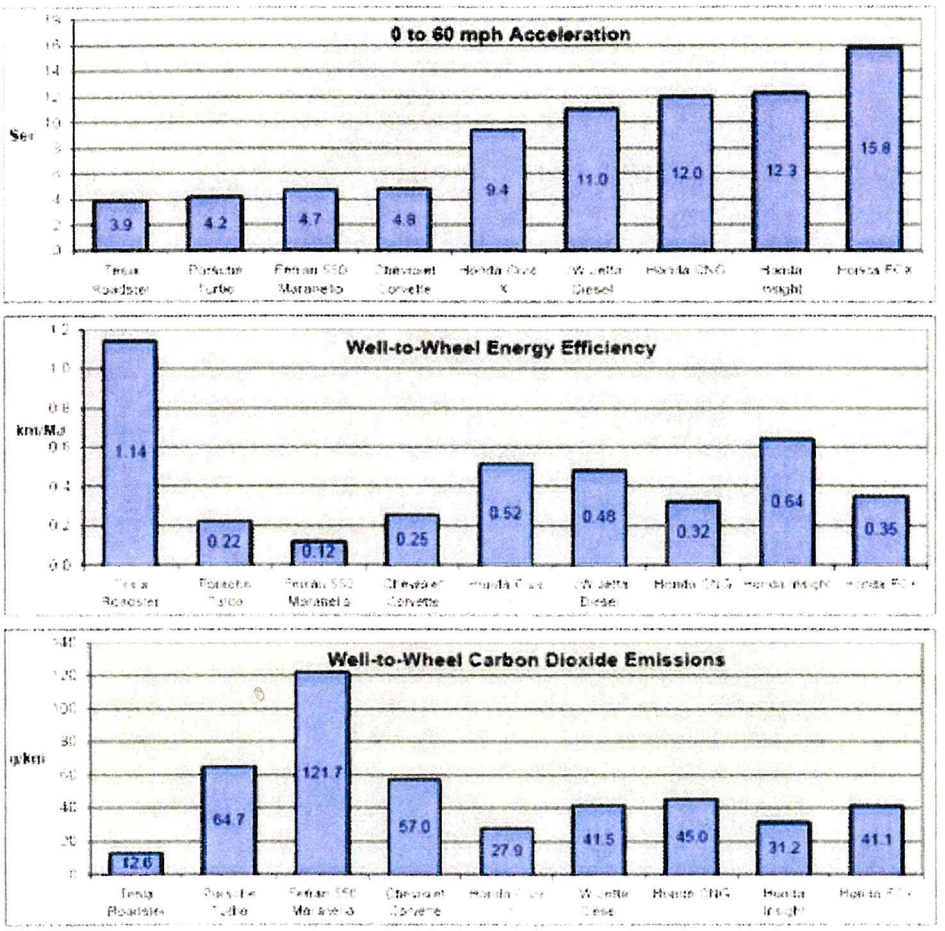
Winning Marketing Strategy

Eberhard's game plan may be to introduce a true enthusiast's car where money is not an issue for its intended demographic segment. The Roadster, not yet publicly available, is projected to cost some $80-$100,000. As a class, the wealthy can most readily buy the cars to help pay the high expenses of a product not yet enjoying the benefits of economies of scale. The intended result is getting them out into the mainstream while the public warms up to its perhaps even bigger market potential for the non-wealthy just a couple years down the road.

Once he has established a phalanx of support from high performance enthusiasts, he can then send out a contingent of moderately priced sedans. Conservatively appointed vehicles with scaled down versions of the Roadster's power system will target the average person's needs and budgets. They are expected to arrive on the scene in 2008. Far more affordable than the

Roadster, the sedan just might help Tesla claim even more solid market share far more quickly than the Roadster has. Also, it would stand to greatly broaden the market for Tesla's vehicles. In fact, a third and even more affordable car model may well hit the market within the next three years.

In so doing, he hopes to dispel the myth that electric cars are by definition inherently "punishment cars," the phrase Eberhard likes to use to refer to his Roadster's erstwhile second cousins



with mediocre styling and room inside. One thing is likely: even without advertising, many automotive enthusiasts will have heard of Tesla before too long.*

*Within less than a month of the Roadster's release, the first 100 vehicle orders for a slightly more expensive limited edition already have been placed.

[*This has been a guest post by Eckhart Beatty. -Ed*]